

Highlights

Vol. II No. 6
April 27, 1959

- * AIRCRAFT METAL FATIGUE
- * RADIATION PROTECTION
- * MOLECULAR ELECTRONICS
- * NEW MILITARY LABORATORIES
- * COMPUTER INPUT DEVICE
- * CHROMATOGRAPHIC UNIT
- * GAS WELL RESEARCH
- * PUBLICATIONS CHECKLIST

Washington SCIENCE TRENDS

AIRCRAFT METAL FATIGUE

Government and industry are cooperating in research and modification programs to prevent and counteract serious fatigue problems in airframe structures of high-performance aircraft. Problems are most apparent in B-47, B-52, B-66 and KC-135 aircraft. Only "stopgap" measures are available at the present time.

* Sonic Fatigue -- This type of deterioration, according to reports released today (Monday), is associated with vibration and pressures created by the blast and sound from jet engine exhaust above the 140 decibel level. As engine thrust continues to increase problem will become greater. This is particularly the case on bomber aircraft which have engines forward of the airframe trailing edges, and in some instances aft of the trailing edges. Aircraft safety is not immediately affected but maintenance costs are high. Sonic fatigue problems are greatest in the B-52, B-66 and KC-135 aircraft. The same problem is anticipated in commercial equivalent aircraft.

Corrective Measures -- In some instances conventional skin is being replaced with honeycomb sandwich-type construction to eliminate cracking. In other instances, ribs are installed to check cracking and breaking of metal parts. Air Force finds that sandwich-type construction takes many times longer to repair as conventional-type skin. Since aluminum alloys are primarily affected, long range programs for faster aircraft envision use of stainless steel or similar materials believed to be less susceptible to sonic failure.

* Cyclic Fatigue -- Materiel failures in the B-47 fleet alerted Air Force and industry to the problems of cyclic fatigue, caused by increased weight, wind pressures, and altitude and temperature pressures. Inspection of aircraft revealed existence of cracks in various wing sections. Cracks were progressive in nature. Failure of the metal occurred at points of high stress concentration. The alloy used, designated 75 ST, was found to be lighter and stronger than others formerly employed, but was less resistant to cyclic fatigue. Major contributing factor in the B-47 was use during relatively new low altitude bombing maneuvers.

Corrective Measures -- Government and industry have been cooperating in extensive cycling ground tests, setting up a spectrum of stresses beyond the expected life of the aircraft. Failures were found in wings, wing fittings and in a longitudinal member. "Beefing up" measures are underway.

MOLECULAR ELECTRONICS

Air Research and Development Command announces today (Monday) a \$2 million development contract in the field of molecular electronics and predicts "drastic reductions" in the size, weight and power requirements for electronic equipment. Contract, with Westinghouse Electric, signals a broad new program effort in this new area.

* Germanium Crystals -- Development centers on dendritic germanium process, which permits the "growing" of germanium crystals as thin, flat uniform ribbons. Raw product was formerly round and about the size of a bullet. Extensive slicing and polishing of the material has been required. Dendritic germanium can be produced in the proper thickness for direct use. Ultra-smooth, mirror-like surfaces are said to need no grinding or polishing of any kind.

* Program Objectives -- Col. Clarence H. Lewis, ARDC Electronics Directorate, states that objective of the program is equipment with inherent dependability, devices with a greatly reduced number of thermal energy consumers, and increases by several orders in magnitude in the amount of electronic functions performed per unit of volume.

In an overall system, Col. Lewis predicts, an electronic system the size of a breadbox might be replaced with one the size of a cube of sugar. The average pocket-sized transistor radio circuitry, excluding the power supply and speaker, could be reduced to the size of the head of a match.

* Feasibility studies are being conducted on a variety of applications including infrared, reconnaissance, flight control, communications and the general sensing of environmental conditions.

Air Force has already conducted demonstrations with a light telemetry subsystem which has a volume of one one-thousandth of a cubic inch and a total weight of two one-hundredths of a gram. Equipment not only measures change in light intensity but also produces a signal capable of transmission to relate the degree of change in intensity, it is reported. Telemetry subsystem components were cut from 14 to 1 and number of soldered connections was reduced from 15 to 2. High reliability potential is said to result.

ELECTROMAGNETIC WAVES

Researchers at the National Institutes of Health have discovered that monkeys can be killed within five minutes by electromagnetic waves of an unannounced frequency aimed at the head from a distance of two feet. The results were contrary to former beliefs, and worked in each of 20 experiments. However, exposure was halted in about half the monkeys before death arrived.

Experiments are expected to provide a new research tool in brain studies and may lead to ways of developing more adequate protective devices against electromagnetic waves.

Dr. Pearce Bailey, Director, National Institutes of Neurological Diseases and Blindness, states: "We feel certain that radio and radar is not dangerous. We have had mysterious airplane accidents, on the other hand. It was always assumed that with the ordinary frequencies these things could not happen, but it appears here if you use a certain frequency and have the head in a certain critical position, it can happen."

RADIATION PROTECTION MEASURES

National Committee on Radiation Protection proposes, in general, a sharp downward revision in the maximum permissible amounts of radioisotopes in the human body, and maximum permissible concentration in air and water. Major changes relate to occupational exposure. Atomic Energy Commission proposes to translate the Committee's recommendations into regulatory safeguards

Legal Status -- Committee evaluated more than 2000 research studies bearing on the permissible dose problem. But the group cautions that its conclusions are not necessarily those of the Atomic Energy Commission or the U.S. Public Health Service. And the National Bureau of Standards, which is publishing the Committee report, disclaims any responsibility for content.

Dose Level Changes -- Levels are, in effect, generally lower than those which have been established in recent years. Some levels have been increased, however, and some remain essentially the same. It is important to note that calculations have been changed from 70 years continuous occupational exposure to 50 years. The committee expressed belief that 50 years was a more realistic figure for radiation workers.

External Radiation Limits -- AEC proposes to limit the total external radiation exposure any worker beyond the age of 18 may accumulate to an average of 5 rems per year and not more than 12 rems in any one year. Present limits are 15 rems per year, and without further restrictions as to the accumulated dose. Rem is defined as a radiation dose of any ionizing radiation estimated to produce a biological effect equivalent to that produced by one roentgen of x-rays.

Validity of Previous Limits -- Do lower limits indicate possible damage under previously recommended levels? AEC takes pains to point out that the committee does not support such an interpretation. Committee has stated that changes "are not the result of positive evidence of damage due to use of earlier permissible dose levels...."

Following table gives a few selected examples of the body burden and maximum permissible concentrations comparing the previous (1953) and current (1959) reports. Table is for continuous occupational exposure. AEC regulations are for 40 hours per week exposure and are, in general, about three times these values:

Element & Organ	Body Burden microcuries		MPC (water) microcuries per cc		MPC (Air) microcuries per cc	
	1953	1959	1953	1959	1953	1959
Ra ²²⁶ bone	0.1	0.1	4×10^{-8}	10^{-7}	8×10^{-12}	10^{-11}
P ³² bone	10	6	2×10^{-4}	2×10^{-4}	1×10^{-7}	2×10^{-8}
I ¹³¹ thyroid	0.3	0.7	3×10^{-5}	2×10^{-5}	3×10^{-9}	3×10^{-9}
Sr ⁹⁰ bone	1	2	8×10^{-7}	10^{-6}	2×10^{-10}	10^{-10}
Cs ¹³⁷ muscle	90	50	1.5×10^{-3}	2×10^{-4}	2×10^{-7}	4×10^{-8}
whole body	---	30	-----	2×10^{-4}	-----	2×10^{-8}
H ³ whole body	10,000	1,000	0.2	0.03	2×10^{-5}	5×10^{-6}

New Military Laboratories

Army, Navy and Air Force are planning a number of new laboratories for science and engineering, research and development. Facilities include programs on solar effects, improved battlefield vision, aircraft fatigue tests, gas dynamics and other fields.

Here is an up-to-date report on plans and programs:

- * Aerospace Propulsion Labs -- Air Force expects to spend over \$5.5 million at the Arnold Engineering Development Center in Tennessee for advanced propulsion work. Gas dynamics test facility is planned to provide accurate aerodynamics, thermodynamic and chemical data on hypersonic missiles. Engine test facilities will be expanded for development support of non-airborne weapons systems including ballistic missiles, military satellites and space vehicles.
- * Aircraft Fatigue Tests: Air Materiel Command plans a laboratory at Wright Patterson Air Force base expected to be the only facility in the U.S. capable of handling large sections of aircraft and missile structures. In addition, a propulsion components testing laboratory is planned for the development of aircraft fuel systems having high-energy fuels.
- * Solid Physics Lab: Air Force Cambridge Research Center, Bedford, Mass. plans a solid physics laboratory for intensive research on solid and gaseous state electronic materials and for high temperature equipment to study effects in the development of high-thrust engines. Also planned is a scientific data collection lab for studies of natural phenomena. Lab will be free from interferences such as air pollution, artificial night glow and chemical reactions that "adversely influence the energy utilized for propulsion of atmospheric vehicles, communications, radar and guidance phenomena to outer regions."
- * Solar Effects: Air Research and Development Command plans a laboratory at Sacramento Peak, Cloudcroft, New Mex. for solar research to develop methods for predicting sun-induced geophysical disturbances.
- * Electronic Countermeasures: Army plans large-scale construction at its Electronic Proving Ground, Ft. Huachuaca, Arizona. New laboratories will cover such fields as telemetry, army field communications, surveillance and avionics. A new countermeasure instrumentation center will be used in connection with equipment designed to counteract variable timer fused free flight missiles. Program includes testing of hunt-lock-on receiver, missile fuse system, bomb fuse system, infrared seeker-type system, fuse disseminators and fuse simulators.
- * High-Level Radiation Lab: Navy plans a \$1.6 million facility at its Research Laboratory, Washington, D.C. for study of radiation phenomena below the range of 10,000 curies. Lab will be used for obtaining data on damaging effects of neutron radiation on construction materials for nuclear submarines, surface ships and aircraft.
- * Army Engineering Labs: Army plans new or expanded laboratories at Ft. Belvoir, Va. in connection with mapping and night-vision research. Target location program will emphasize development of techniques and equipment for high dependability geodetic information to determine accurately the location of targets for surface-to-surface missiles in combat areas. Night Vision equipment branch, predicting a three-fold expansion in the next year, will consolidate and equip laboratories for recently initiated projects on image intensification and battlefield illumination.

FOSDIC III -- Computer Input Device

National Bureau of Standards has built a new model of its FOSDIC (Film Optical Sensing Device for Input to Computers) to facilitate transcribing microfilmed data onto magnetic tape in connection with the 1960 Census. Device will replace human operators who have, in the past, transcribed information onto punched cards.

* Electronic Scanning Assembly - An electronic scanning assembly is the central element of FOSDIC III. Bureau reports light from the screen of a cathode-ray tube is focussed on a microfilm image. A photoelectric cell measures small, discrete areas on the film which correspond to the hand-written marks on the original document. Any selected area of the image can be examined by moving the electron beam around on the face of the cathode-ray tube.

Control of the position of the illuminated area, and interpretation of the signals from the photoelectric cells, are performed by associated electronic circuitry. The point of light travels in a prescribed manner through positional control, or scanning. As soon as one image is scanned, the film is automatically advanced to the next frame.

* Microfilm Advantages - Bureau reports a number of advantages derived from photographing the census documents on 16-mm microfilm. It separates the massive paperwork operation from the electronic equipment; FOSDIC can read microfilm images much faster than the paper sheets themselves. High contrast of microfilm enhances signal-to-noise ratio.

Original documents, once microfilmed, need not be stored. Microfilm quality permits film images to be examined directly with a reader. Bureau also reports documents can be photographed on a pile, permitting rapid peel-off, documents may be slightly tilted so that straightening is not continually required, and precise reduction ratio and exposure control are not necessary.

* Mark Sensing System: Census documents will employ a mark sensing system in which answer areas are marked with ordinary pencils or left blank. Numbers may be selected by choice from a column of ten digits. Each group of questions is located by an index mark such as a black square which FOSDIC can easily find. Answer marking positions fall into an imaginary grid laid off from index. Grid is made up of modules 0.15 in. square, and marking areas may be packed this closely together, horizontally or vertically. Device can be programmed to read off any part or all of the information on a document. Instructions are in terms of the horizontal and vertical coordinates of the index mark next to the desired information. Program control is through a plugboard into which detection logic has been wired.

(Some additional details available. Free. Write National Bureau of Standards, Office of Technical Information, Washington 25, D.C. for Summary Technical Report No. 2352)

RESEARCH CHECKLIST

- () New Chromatographic Unit: U.S. Navy researchers have designed and constructed a new gas-liquid chromatographic unit which can be modified at will for new applications. The carrier gas flows from a pressure tank equipped with a two-stage pressure reducing valve through a coiled tubing preheater, into a reference chamber; through a thermal conductivity cell and into the sample injection system where the sample is vaporized. The flow continues into the chromatographic column and into the sample-detector part of the thermal conductivity cell, and finally through the flow meter. Device was employed in analysis of ethanol-water-ether, carbon tetrachloride-acetone, ethanol-chloroform, and carbon tetrachloride-chloroform solutions.

(Research by U.S. Naval Powder Factory, Research and Development Department, Indian Head, Md. Report available. 33 pages. \$1. Order PB 151 008 from OTS, U.S. Department of Commerce, Washington 25, D.C.)

- () Niobium Research: Investigations sponsored by the Atomic Energy Commission indicate that oxidation resistance of Niobium can be increased up to 100 fold by addition of alloys such as chromium, molybdenum, titanium and vanadium. The studies support the belief that Niobium can be counted among the most attractive Metals as a base for high temperature alloys.

(Research by Battelle Memorial Institute, Columbus, Ohio. Report available. 62 pages. \$2.25. Order BMI-1317 from OTS, U.S. Department of Commerce, Washington 25, D.C.)

- () Polymer Research: National Bureau of Standards has been investigating the mechanical degradation of polymers in connection with the Government's synthetic rubber program. Research indicates that the use of polymers which degrade excessively under severe conditions can be avoided and special polymers which will remain intact under such conditions can be developed. Research has applications in such technological processes as lubrication, pumping, ultrasonics, milling, shaking, turbulent flow and lamellar flow.

(Report available. Free. Write National Bureau of Standards, Office of Technical Information, Washington 25, D.C. for Summary Technical Report No. 2336)

- () Extreme Temperature Measurement: Studies for the U.S. Air Force have led to development of an experimental gas radiation pyrometer applicable to measurement of the extreme temperatures of combustion gases in jet engines. Selective detectors that utilized the absorption of carbon dioxide and other types of filters were built and tested. Pure silver was found to be the most promising material for the body of the device, with gold-plated copper a possibility. Synthetic sapphire and silver soldered to a metal flange showed possibilities for window material. Platinum and platinum-10 percent rhodium wire of small diameter appeared worthwhile for thermopile material.

(Research by the Perkin-Elmer Corp. for Wright Air Development Center. Report available. 62 pages. \$1.75. Order PB 151 031 from OTS, U.S. Department of Commerce, Washington 25, D.C.)

- () Gas Well Research: U.S. Bureau of Mines has developed a new, inexpensive technique in which detergent solutions restore productivity in natural gas wells by removing water accumulations which hinder or prevent output. Detergents capture gas in the water, which then rises to the surface as a column of foam. Research is underway to make the process continuous. Other Bureau studies in progress indicate that accumulations of "condensate" of natural gas liquids can be removed by the same technique, using chemicals that will create a foam in such hydrocarbons.

(Details available. Free. Write U.S. Bureau of Mines, Petroleum Experiment Station, Bartlesville, Oklahoma)

- () Cobalt Research: U.S. Public Health service reports "a rather large percentage of employees" at a cobalt refinery in Utah have experienced "respiratory distress" and are under study. Service is attempting to define the disease and its possible occupational relationship. Cobalt production is being increased because of its importance as an alloy in the manufacture of jet aircraft engines.
- () Aircraft Periscope: Navy is sponsoring development of a periscope for pilot protection from an atomic flash. Device permits reduction of visual opening in windscreen to a slot about one inch high, while retaining a larger field of view. Opening can be closed automatically in microseconds for flash protection, leaving the pilot his instrument flying capability. Fabrication for flight test is underway.
- () Doppler Radar: Air Research and Development Command has been running military qualification tests on a doppler radar system designed to provide a ground speed and drift reading, to be fed into bombing and navigation system. Device provides a ground position indicator. Procurement of \$25.9 million is planned
- () Nuclear Magnetic Resonance: National Institutes of Health, Bethesda, Md. are using advanced electronic techniques to determine in detail the nature of molecular arrangements and bond shapes. Test substances are placed in a strong and very stable magnetic field and are "bombarded" with radio waves. Varying absorption of frequencies indicate the kinds of atomic particles present and precisely where they are located. Magnetic field must not vary more than one part in a million for effective results. Studies may permit researchers to synthesize insulin and other biological materials.
- () Space Vehicle Power: National Aeronautics and Space Administration engineers propose a nuclear turboelectric powerplant suitable for manned space vehicles. Thermodynamic cycle was selected, using sodium vapor as a working fluid and operating at a turbine-inlet temperature of 2500°R. Total powerplant weight calculated at about 6 pounds per kilowatt. Radiator necessary for rejecting cycle waste heat contributes about 2.1 pounds per kilowatt to the total weight.

(Report available. 65 pages. Free. Write NASA, Division of Research Inf., 1520 H Street, N.W., Washington 25, D.C. for NASA Memo 2-20-59E)

- () Cryogenic Pump: NASA engineers have devised a low-speed five cylinder piston pump to handle boiling hydrogen and possibly other cryogenic fluids. Pump is designed to deliver 55 gallons per minute at a discharge pressure of 135 pounds per square inch.

(Report available. 27 pages. Free. Write NASA, Division of Research Information, 1520 H Street, N.W., Washington 25, D.C. for NASA Memo 3-6-59E)

PUBLICATIONS CHECKLIST

- () Telomerization, a Naval Research Laboratory study of the processes involved in the formation of short polymer chains by chain transfer of a polymer radical with a substance other than the monomer. The overall process is designated as "telomerization" and literature dealing with materials and processes is reviewed. 71 pages. \$2. (Write OTS, U.S. Department of Commerce, Washington 25, D.C. for PB 131930)
- () Fatigue of Metals and Structures, a standard Government manual on the design of structures and machine parts to avoid fatigue failures under repeated stressing. Covers nature of fatigue failures, fatigue damage, stress, high temperature, detection of fatigue and similar topics. 399 pages. \$1.75. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Publication No. D 202.2:M 56)
- () Space Balloons, describes the NASA 12-foot inflatable sphere, separation mechanism, ejection and disconnect mechanisms and boosting rocket motors. Includes results of vacuum tank and flight tests. 18 pages. Free. (Write Technical Information Office, NASA, 1520 H Street, N.W. Washington 25, D.C. for NASA Memo 2-27-59E)
- () Atomic Energy Patents, Volume I of a comprehensive study. A compilation of materials from a number of sources including some published for the first time. 289 pages. Free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D.C. for Selected Materials on Atomic Energy Patents)
- () Sea Water, Proceedings of a 1958 conference on the physical and chemical properties of sea water, new types of research instrumentation and future research needs. Of interest in basic research, oceanography, anti-submarine warfare and other fields. 202 pages. \$2. (Write Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D.C. for Publication No. 600)
- () Reactors, a new book of nuclear reactor information, including some newly declassified details on 95 research and test reactors in the U.S. as well as other facilities in Canada, South America, Western Europe and Asia. Covers operation, cost, status, fuel, coolant, control, research facilities, bibliography and detailed diagrams. 297 pages. \$7.50. (Write Order Department, ASME, 29 West 39th St., N.Y. 18, N.Y.)
- () Titanium Sponge, describes method developed by the Bureau of Mines for rapidly determining the quality of titanium sponge; also covers methods used in preparing samples, method of melting and surfacing test ingots. 18 pages. 15 cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Bureau of Mines Report 5440)
- () Defense Procurement, a newly revised handbook on Selling to Navy Prime Contractors. Just published. 40 cents. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Publication No. D 201.2:SE 4/20 959)
- () Electronic Scanning, the proceedings of unclassified portions of a symposium held at the Air Force Cambridge Research Center in 1958. Covers scanning arrays, new type scanners, advanced phase shifters and other developments. \$11.10 in microfilm. \$42.60 in photoreproduction. (Write Library of Congress, Photoduplication Service, Washington 25, D.C. for PB 135 598)

